North Dakota Department of Transportation

Guidelines for the Installation of Turn Lanes along State Highways

July 2011

These guidelines include the following sections:

I. Turn Lane Criteria for Non-Controlled Approaches with a Posted Speed ≥ 50mph.
II. Turn Lane Criteria for Controlled Approaches or Approaches with a Posted Speed ≤ 45mph
III. Turn Lane Offsets
IV. Cost Participation and Timing of Turn Lane Installation
V. Turn Lane Design
VI. Turn Lane Maintenance

For the purposes of these guidelines, driveway and alley accesses are not considered to be intersections.

I. Turn Lane Criteria for Non-Controlled Approaches with a Posted Speed ≥ 50mph

This section is applicable to non-controlled[1] approaches with a posted speed limit ≥ 50mph[2]. Criteria I.A through I.C apply to intersections only. Criteria I.D and I.E apply to intersections, driveways, or alleys. Left or right turn lanes may be installed at the option of NDDOT if one of the below criteria is met.

Volume Criteria

I.A For non-divided highways, the major corridor AADT (two-way traffic) is ≥ 750 vehicles per day and the left or right turn movement (single direction) is ≥ 125 PCE[3] vehicles per day.

I.B For divided highways, the major corridor AADT (two-way traffic) is ≥ 750 vehicles per day and the left or right turn movement (single direction) is ≥ 75 PCE[3] vehicles per day.

I.B.1 The volume criteria for divided highways are less than non-divided highways for the following reasons:

- -Due to the highest speeds (except for interstates), divided highways have the largest speed differentials between through and turning vehicles.
- -Due to the main function being mobility of through traffic, many drivers do not expect to have to avoid slow-moving vehicles that are slowing to turn.
- -It is often less expensive to install turn lanes on divided highways. Left turn lanes can simply be added in the median, whereas non-divided highways typically need some sort of re-alignment. Divided highways typically have a larger outside (right) shoulder than non-divided highways, so less dirt work is typically needed to install right turn lanes.

1 Non-Controlled means the approach is not controlled with a traffic signal, stop sign, or yield sign. At typical intersections the mainline approaches are non-controlled (i.e. free) and the side street approaches are stop-controlled.

2 50mph is the lower limit for high-speed design, according to the AASHTO Green Book (page 72, 2001 Ed.).

3 PCE = Passenger Car Equivalent, see conversion equation in section I.B.2.

I.B.2 AADT turning volumes should be converted to PCE (Passenger Car Equivalent) turning volumes using the below equations and table.

$$\text{PCE Turning Volume} = \text{AADT Turning Volume} * T_{adj}$$

$$T_{adj} = 1 + P_T*(E_T - 1)$$

where

T_{adj} = truck adjustment factor

P_T = the percentage of trucks (expressed as a decimal)

E_T = passenger car equivalent for trucks, from below table

E_T based on Type of Terrain[4]	
Level ≤ 2%	**Rolling > 2%**
1.5	2.5
1 truck = 1.5 cars	1 truck = 2.5 cars

Example Problem

Given:

Non-Divided Highway
Speed Limit = 65mph
Mainline Grade = 3.5%

Mainline AADT = 2000 veh/day
NB to WB Left Turn AADT = 100 veh/day
NB to WB Left Turn % Trucks = 25

What is the NB to WB Left Turn PCE (Passenger Car Equivalent) Volume?

Method #1 (fewer steps)

T_{adj} = 1 + P_T*(E_T - 1)
= 1 + 0.25*(2.5 - 1)
= 1.375

Left Turn PCE = Left Turn AADT * T_{adj}
= 100 veh/day * 1.375
= 137.5 PCE/day

Left Turn PCE = round to 138 PCE/day

Method #2 (more steps)

Left Turn Trucks = 25% * Left Turn AADT
= 0.25 * 100 veh/day
= 25 trucks/day

Left Turn Cars = Left Turn AADT – Left Turn Trucks
= 100 veh/day – 25 trucks/day
= 75 cars/day

Left Turn PCE = Left Turn Cars + (Left Turn Trucks * E_T)
= 75 cars/day + (25 trucks/day * 2.5)
= 75 + 62.5
= 137.5 PCE/day

Left Turn PCE = round to 138 PCE/day

Is criterion I.A satisfied to install a NB to WB left turn lane?

Major Corridor AADT = 2,000 (which is ≥ 750 minimum)
Left Turn PCE = 138 (which is ≥ 125 minimum)

Yes, criterion I.A is satisfied.

4 Based on TRB's Highway Capacity Manual (page 21-8, 2000 Ed.).

Crash Criteria

I.C There have been 2 crashes in 3 years or 3 crashes in 5 years, of crash types susceptible to correction by a turn lane.

Engineering Judgment

I.D A turn lane is recommended based on engineering judgment as part of a traffic operations study.

Other Criteria

I.E The previous criteria are not met or do not apply, but a turn lane is requested and the requestor agrees to pay up to 100% of the installation costs. See section IV for cost participation scenarios.

II. Turn Lane Criteria for Controlled Approaches or Approaches with a Posted Speed ≤ 45mph

This section is applicable to controlled[5] approaches (any speed) and non-controlled approaches with a posted speed limit ≤ 45mph. Criteria II.A and II.B apply to intersections, driveways, or alleys. Left or right turn lanes may be installed at the option of NDDOT if one of the following criteria is met:

Engineering Judgment

II.A A turn lane is recommended based on engineering judgment as part of a traffic operations study.

Other Criteria

II.B Criteria II.A is not met or a traffic operations study has not been performed, but a turn lane is requested and the requestor agrees to pay up to 100% of the installation costs. See section IV for cost participation scenarios.

5 Controlled means the approach is controlled with a traffic signal, stop sign, or yield sign. At typical intersections the mainline approaches are non-controlled (i.e. free) and the side street approaches are controlled with stop signs.

III. Turn Lane Offsets

Left Turn Lane Offsets

A. Left turn lanes are sometimes installed with a negative offset (Figure 1a), especially at divided highway intersections. However, as appropriate, a traffic operations study may recommend that opposing left turn lanes be installed with zero offset or positive offset (Figure 1) based on engineering judgment. Positive offset left turn lanes improve the visibility of oncoming through traffic, allow left-turning drivers to utilize the available gaps more effectively, and decrease the possible conflict between opposing left-turning vehicles.

1) If feasible, negative offset left turn lanes should not be installed or re-installed at:
   -intersections with left turn crash trends,
   -intersections with sight distance issues,
   -unsignalized intersections where the mainline AADT is 1500 or greater and the mainline left turn lanes both have 30 or more left-turning vehicles during the same one hour, or
   -signalized intersections with permissive-only or protected-permissive left turn phasing.

Right Turn Lane Offsets

B. Right turn lanes are typically installed adjacent to the through lane. However, as appropriate, a traffic operations study may recommend that an offset right turn lane (Figure 2) be installed based on engineering judgment. Offset right turn lanes give drivers on the minor approach (at the stop bar) an unobstructed view of through traffic in the near lanes, which allows for more effective use of gaps. When implementing offset right turn lanes, ensure the horizontal geometry of the roadway does not negate the line-of-sight improvement.

1) Some examples of locations where offset right turn lanes may be beneficial are:
   -intersections where a crash trend (susceptible to correction by an offset right turn lane) has been identified,
   -intersections with large volumes of turning trucks, or
   -intersections with sight distance issues.

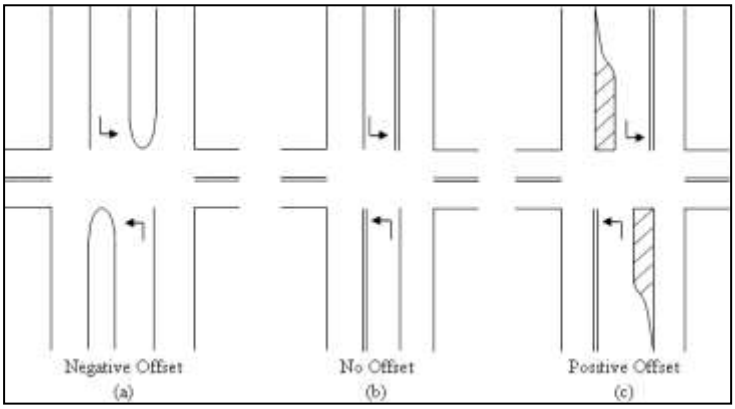

Figure 1 – Left Turn Lane Offsets


Figure 2 – Offset Right Turn Lane

IV. Cost Participation and Timing of Turn Lane Installation

A. At the intersection of two state highways, NDDOT should pay 100% of the installation costs.

B. At the intersection of a state highway and a public road, if the turn lane criteria are met NDDOT should pay 100% of the turn lane installation costs. This does not apply if only criterion I.E or II.B is met.

C. At the intersection of a state highway and a public road, if only criterion I.E or II.B is met the responsible local agency should pay up to 100% of the turn lane installation costs.

D. At driveway or alley accesses, the turn lane requestor should pay 100% of the turn lane installation costs.

E. Timing of turn lane installation is dependent upon multiple factors, such as: availability of funds, the approval process, weather, possibly waiting so the turn lane installation can be tied to an upcoming construction project, etc.

   1) If NDDOT is paying to install a turn lane and if there is an upcoming project in the STIP (Statewide Transportation Improvement Program), consideration should be given to installing the turn lane as part of the upcoming project (typically using the project's funding, rather than HSIP funding).

V. Turn Lane Design

A. New turn lanes shall be designed according to section III-03.05.01 of NDDOT's Design Manual.

B. Plans and specifications for all turn lanes to be installed off of or onto state highways shall be subject to approval by NDDOT.

C. Turn lanes, including the taper area, should be kept clear of any additional points of access.

D. Section III-16 of the NDDOT Design Manual discusses driveways and access management.

VI. Turn Lane Maintenance

A. After installation and final acceptance, NDDOT should typically accept responsibility for turn lane maintenance.